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Fish diversity and distribution in two protected rivers, Sardabrud and Chalus, southern Caspian Sea basin, Iran

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Abstract: Fish species diversity, distribution and abundance were studied in the Sardabrud and Chalus rivers, in the Southern Caspian Sea Basin, during 1992 and 1993 in five and four stations respectively, by monthly collections using electrofishing device. In total, 3200 fish specimens, including 15 species in Sardabrud River and 12 species in Chalus River, were investigated. The fish comprised of 13 genera and 5 families: Petromyzontidae, Cyprinidae, Cobitidae, Salmonidae and Gobiidae; the majority being Cyprinidae. This is the first report of *Pseudorasbora parva* in Sardabrud River. The Shanon's index for Sardabrud River ranged from 0 to 1.77 and for Chalus River from 0 to 1.91. Fish species diversity was significantly correlated with altitude (r^2= 0.96 and P< 0.01). The species diversity increases as one moves from the headstream towards the estuaries of the two studied rivers. Species diversity was independent of position but dependent on depth alone.

Keywords: Chalus River, Fish Distribution, Sardabrud River, Species Diversity.

Introduction

Identifying environmental gradients that influence community structure (Minshall 1988; Power et al. 1988; Pyron & Lauer 2004) and also environmental factors influencing their distributional ecology (Mares 1986; Oberdorff et al 1995; Hump & Pivnicˇka 2006) are the major focus of river ecology. Studies of fish assemblages have shown that abiotic factors such as temperature, current velocity and substrate can determine the distribution and abundance of individual species as well as influence community-level properties such as species richness, production and guild composition (Lotrich 1973; Gorman & Karr 1978; Matthews 1985). Some studies (Kuehne 1962; Harrel et al. 1967; Sheldon 1968; Harrel & Dorirs 1968; Hynes 1970; Whiteside & McNath 1972; Jenkins & Freeman 1972; Cashner & Brown 1977) have clearly demonstrated that diversity increases as stream order increases and the number of individuals may decrease while biomass remains the same or increases. This can be attributed to an increase in available habitat and a decrease in environmental fluctuation (Harrel et al. 1967; Harrel & Dorris 1968; Whiteside & McNath 1972). The objective of this study was to investigate the fish fauna and quantitative distribution of fishes in Sardabrud and Chalus rivers (Caspian Sea Basin). These two rivers have been given the "protected" status for more than two decades by the Iran Department of Environment.

Materials and methods

Fish specimens were collected using an electrofishing device with 300-400V in Sardabrud and Chalus rivers, in the Southern Caspian Sea Basin, during 1992 and 1993 on a monthly basis in five and

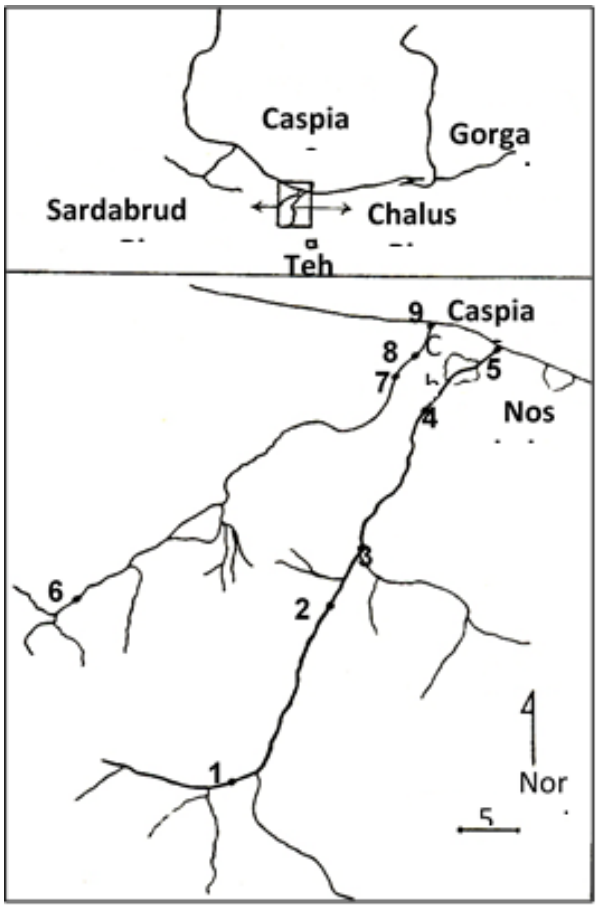

Fig.1. The study sites (1-5, sites of Chalus River and 6-9, sites of Sardabrud River).

four stations (Fig. 1), respectively. All the specimens were preserved in 10% formalin at the spot. Species diversity for each sample was calculated from the Shannon and Weaver (1949) formula: $H=-\Sigma p_i \ln p_i$, where p_i is the proportion of individuals in the sample that belong to species i. Some characters of the river habitat such as temperature, current velocity and substrate were measured. The correlation between fish species diversity and river and throughout characteristics in both Rivers were calculated using a linear regression model.

Results

In total, 3200 specimens of fish were examined in the catches collected from the two rivers during the 12 month study period in 1992 and 1993. The fish community at the study site consisted of 15 species in Sardabrud River and 12 species in Chalus River representing 5 families (Table 1). Physico-chemical

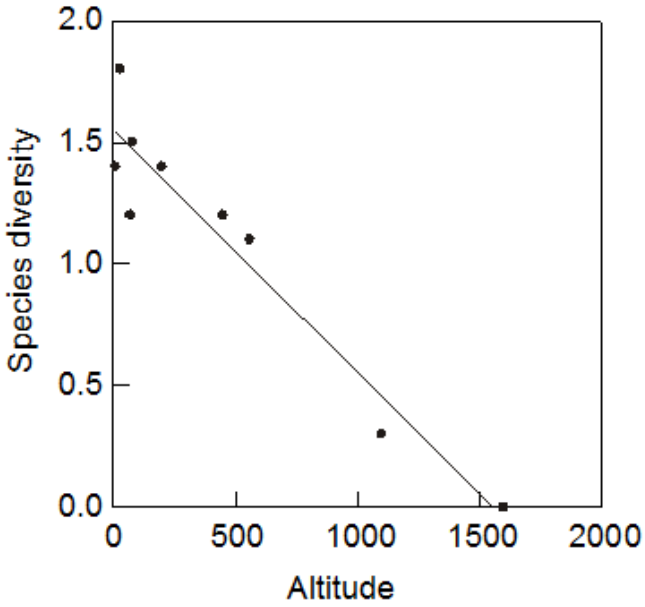

Fig.2. Regression model showing the relation between altitude and fish species diversity.

characteristics of the two rivers are shown in Table 2. In terms of number of species, the Cyprinidae had the highest diversity; 73.3% in Sardabrud River and 75% in Chalus River. Of the total fish species, 66.7% in Sardabrud and 73.3% in Chalus River were resident and the remaining were migratory. The population estimations changed considerably at different seasons and localities. Due to some logistic problems, the fish density was only estimated for Sardabrud which ranged from 3538 to 16326 fish per hectare. Biomass ranging from 48.4 to 62.5 kg per hectare. *Pseudorasbora parva* was reported for the first time in Sardabrud. It was found that fish species diversity and altitude had an inverse relationship (Fig. 2). Average Shannon-Weaver fish species diversity estimates ranged from 0 to 1.91.

Discussion

Fish species diversity increased from the head river toward the estuaries of both Rivers. The choice of factors to be analyzed is extremely difficult, since environmental variables in streams are typically correlated and confounded with one another (Reid 1961). Almost any variable chosen will have some predictive value, but causation must be determined from independent observations.

Table 1. Some characteristics of fish species distribution in Sardabrud and Chalus rivers.

Family and species	Chalus River					Sardabrud River				Resident	Migratory
	station					station					
	1	2	3	4	5	6	7	8	9		
Petromyzontidae											
Caspiomyzon wagneri						-	0.7	1.2	1	-	+
Salmonidae											
Salmo trutta (migratory)		-	-	-	0.7	-	-	-	0.09	-	+
Salmo trutta(resident)	90.9	-	0.3	-	-	100	2.1	-	-	+	-
Cyprinidae											
Alburnoides eichwaldi	-	12.7	51.5	47.6	3.2	-	57	31.7	45.9	+	-
Luciobarbus capito	-	-	-	-	1.2	-	-	3.6	1.2	-	+
Luciobarbus mursa	-	-	0.3	2.4	11	-	-	2	0.3	+	-
Barbus lacerta	9.1	24.1	3.1	14.9	3.9	-	4.9	5.4	2.3	+	-
Capoeta capoeta	-	-	3.1	9.1	64.1	-	19	31.4	18.3	+	-
Carassius auratus						-	-	8	5.8	+	-
Alburnus chalcoideas	-	-	-	-	1.3	-	-	2.5	4.4	-	+
Squalius cephalus	-	4.3	10.4	9.1	-	-	-	-	0.7	+	-
Pseudorasbora parva						-	-	0.3	0.09	+	-
Rhodeus amarus						-	-	-	0.3	+	-
Rutilus kutum	-	-	-	-	7.7	-	-	1	18.4	-	+
Vimba persa										-	+
Cobitidae											
Cobitis sp.	-	-	-	-	0.7	-	-	-	0.4	+	-
Gobiidae											
Neogobius fluviatilis	-	58.9	31.3	16.9	2.9	-	16.3	13.9	0.8	+	-

The abiotic factors such as current velocity, temperature and substrate can determine the distribution and abundance of individual species (Rahel & Hubert 1991). In a stream, the major factor which influences fish diversity is the water depth (Sheldon 1968; Gorman & Karr 1978). High water velocities seemed to reduce the effective depth, because fish can not occupy the entire water column (Sheldon 1968). We calculated fish species diversity and altitude, because altitude is really a residual which can include a whole array of correlated variables (Sheldon 1968; Reyjol et al. 2003). The relative abundance and diversities of its component functional groups fluctuate in predictable cycles with the alternating hydrological regimes of the river. Different species may live in habitats of similar structure, thus increasing total species diversity of localized units (Sheldon 1968). Shelford (1911) and Thompson & Hunt (1930) support the importance of within habitat concept of diversity among stream fishes in the temperate zone. Shelford (1911) explained the distribution of fishes in terms of the geological concept of age of stream beds. Foltz (1982), fish abundance increased downstream and with depth, but was also influenced by substrate characteristics known to influence distribution of aquatic insects. The deep areas at downstream sites probably favored fish species richness because they potentially allow the coexistence of numerous fish species, as suggested by Sheldon (1968).

Implications for conservation, management, and research: Conservation efforts in Iran have focused

Table 2. Physico chemical characteristics of the studies area in Chalus and Sardabrud River. S= Stone, 10-30 cm, G= Gravel, 0.5-10 cm, B= Bolder, >30 cm, C= Clay, <0.5 cm.

Characters	Chalus River					Sardabrud River			
	station					station			
	1	2	3	4	5	6	7	8	9
Characteristic geography	36°18'N 51°13'E	36°27'N 51°18'E	36°38'N 51°20'E	36°40'N 51°23'E	36°29'N 51°27'E	36°29'N 51°02'E	36°39'N 51°22'E	36°39'N 51°22'E	36°41'N 51°13'E
Altitude (km)	1100	560	450	200	80	1600	70	30	10
Distance from sea (km)	52	33	26	9	0.2	45.3	6	3.3	1
Stream width (m)	10.6	16.5	18.9	19	26.5	8	12	23	18.5
Depth (m)	0.35	0.3	0.45	0.45	0.5	0.3	0.4	0.3	0.7
Substrate	S>B>G >C	S>G>B >C	S>G>B >C	S>G>B >C	G>C>S	B>S>G	B>S>G	G>S>C	C>G
Water velocity (m/s)	1.3	1.2	1.4	1.4	1.3	1.3	1.1	1.1	0.3
Water temperature (°C)	9	13	13.6	14.8	16.1	7.1	11.9	13.8	15

primarily on mammals and birds, whose distributions are better known. There is little basis to evaluate how these efforts might affect fish communities. Identification of river zones and their characteristics may provide ecologically meaningful unites for river management. Comparable studies in other rivers are necessary to determine generality of the longitudinal and lateral zonation patterns that we observed. We expect that similar patterns will be found in other large southern Caspian Sea Rivers.

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